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FOREST SERVICE  
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## ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

### Timing Cacodylic Acid Treatments for Control of Mountain Pine Beetles in Infested Ponderosa Pines

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Careful timing is critical to success in post-attack use of cacodylic acid against mountain pine beetles. Acid must be introduced into infested trees before any larval galleries exceed 0.5 inch in length to achieve satisfactory beetle mortality. Since the beetle attack period may last more than 1 month, more than one visit per area will be necessary to locate and properly treat all the trees that become infested.

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Results of a 1968 field test in the Black Hills of South Dakota indicated that cacodylic acid (dimethylarsenic acid) could be effective in control of mountain pine beetles (*Dendroctonus ponderosae* Hopk.) infesting ponderosa pine (*Pinus ponderosa* Laws.) (Chansler et al. 1970). Since timing of the acid application was seen as a critical factor, and the desirability of an extended treating period was recognized, a series of small field tests was started in 1969 to determine if applications made later in the season than immediately after attack might still be effective. The necessity of further study was reinforced by the apparent failure of a separate, more extensive field test in the Black Hills in 1969, one carried out in roughly the same manner as the successful 1968 project. The approach in all these instances, as well as the

experiments related here, was to introduce the material after beetle attack, in an attempt to prevent brood development.

#### Methods

Two similar experiments were conducted in 1969, one in the Black Hills and one in the Front Range of the Colorado Rockies, in Larimer County. In each instance, a group of recently (1969 attack) infested trees was chosen, and randomly selected individuals were treated with cacodylic acid at intervals as late as into November (in South Dakota). Similar experiments were conducted in the Black Hills in 1970, and in Colorado in 1972. Treating techniques, using full-strength Silvisar® 510,<sup>4</sup> were as described by Chansler et al. (1970). Establishment data on the four experiments are as follows:

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<sup>4</sup>Trade name for a solution manufactured by the Ansul Company, Marinette, Wisconsin, that contains the equivalent of 5.7 pounds of cacodylic acid per gallon. Trade names and company names are used for the benefit of the reader, and do not imply endorsement or preferential treatment by the U.S. Department of Agriculture.

Experiments and treatment dates	Number of trees Treat- ments	Checks	Mean tree diameter (Inches)
South Dakota, 1969 Sept. 5,19 Oct. 3,17,31 Nov. 14	24	12	11.9
Colorado, 1969 Sept. 11,18 Oct. 2,16,30	25	10	13.3
South Dakota, 1970 Aug. 21,28 Sept. 4,12,23	25	10	--
Colorado, 1972 Aug. 17,25 Sept. 6,15,25	25	10	12.3

Typically, five trees were treated on each date (four in the South Dakota 1969 test), and two trees were designated as that treatment's checks.

Egg and larval gallery length, brood, and bluestain development were recorded from two galleries each in check trees at time of treatment, to determine if one or more of these characteristics could be used as timing guidelines. Bluestain was judged (1) absent, (2) just identifiable (light), or (3) well developed.

The results of the experiments were evaluated prior to emergence the summer following treatment; that is, the 1969 treatments were evaluated in summer 1970. Bark samples, 6 by 6 inches square, were removed from north and south sides of trees at about eye level. Length of egg gallery and numbers of live insects were recorded.

In the 1969 Colorado experiment, north and south bark samples were also removed from the mid and upper infested portions of the bole, and several trees were felled for this purpose in the 1969 South Dakota experiment. The eye-level samples always had the most live insects, however, and in the remaining experiments only eye-level samples were taken.

The results from north and south samples were combined, and the numbers of insects and length of egg galleries were computed on a square-foot basis. In the final evaluation, data were combined for the check trees; that is, gallery length and insect numbers from all check trees were pooled for each experiment. One-way analysis of variance with log ( $x + 0.1$ ) transformation of counts ( $x$ ) was used for comparison of treatments and checks.

### Results and Discussion

All trees were equally attacked, as measured by mean length of egg gallery: treated 94.7 in/ft<sup>2</sup>, checks 101.4.

The mean number of surviving mountain pine beetles in infested ponderosa pines versus

the time of the cacodylic acid treatment in the four experimental areas was as follows (means followed by the same letter are not significantly different at the 0.05 level):

Experiments and treatment dates	Survivors (Number/ft <sup>2</sup> )
South Dakota, 1969	
Sept. 5	17.0 a
Sept. 19	59.0 b
Oct. 3	77.5 b
Oct. 31	103.0 b
Nov. 14	50.0 b
Check	89.2 b
Colorado, 1969	
Sept. 11	13.2 a
Sept. 18	8.0 a
Oct. 2	2.0 a
Oct. 16	37.2 ab
Oct. 30	12.4 a
Check	47.0 b
South Dakota, 1970	
Aug. 21	0.0 a
Aug. 28	3.6 a
Sept. 4	30.8 b
Sept. 12	16.0 ab
Sept. 23	4.8 a
Check	50.8 b
Colorado, 1972	
Aug. 17	0.0 a
Aug. 25	4.8 a
Sept. 6	0.8 a
Sept. 15	3.6 a
Sept. 25	20.4 b
Check	45.6 b

The 1969 results from South Dakota were unsatisfactory. Even in the earliest treatment (September 5), a mean of 17 beetles per ft<sup>2</sup> survived. While this value was significantly different from those of the other dates, and the check, it would not result in a "decreasing" infestation according to the commonly used criteria (Knight 1960). All later treatments allowed development of in excess of 50 beetles per ft<sup>2</sup>—totally unacceptable. The 1969 Colorado results were somewhat more encouraging—all but one treatment differed from the check—but no clear-cut timing pattern was established.

It was felt that most of the 1969 treatments were probably too late, even though only eggs were noted and bluestain was at best lightly developed at the time of the first treatments. This prompted earlier treatments in 1970 and 1972, which fairly well spanned the time period following attack during which we could expect effectiveness.

The 1970 South Dakota trial was an improvement over that of 1969, but the numbers of living beetles in the two earlier September treatments (30.8 and 16.0 per ft<sup>2</sup>) were still too high



to be considered satisfactory, and were not significantly different from the checks.

Extra care was taken in frilling and applying the material in 1972, and the results of this test were acceptable (means of 0, 4.8, 0.8, and 3.6 living beetles per ft<sup>2</sup> for the treatments through September 15). All differed significantly from the check.

Bluestain does not seem practically useful as a guideline for timing, as it is impossible in the field to identify developmental stages that might be indicators of the trees' ability (or lack thereof) to translocate the acid. Certainly by the time bluestain is well developed (table 1), it is too late to kill the beetles. On a practical basis, if bluestain is detectable the chances for success with acid are poor.

Length of larval mines appears to provide a more useful guideline. With the exception of the 1969 South Dakota experiment, results were generally good if cacodylic acid was applied before any larval mines were greater than 0.5 inch long.

Throughout these experiments, we have been impressed with the importance of making a good frill and using sufficient material. These details cannot be overemphasized.

The duration of the attack period is another important consideration. We have seen that acid

must be introduced soon after attack. While all infested trees may be successfully treated on—say—August 25, more trees may well be attacked in the same area during the following 1 or 2 weeks. If only a single pass is made through the area, some infested trees may not get treated, and some of the value of the program may be wasted. While August 20 is generally a good date to consider for the mean mass attack (McCambridge 1964), we must remember this is the mean mass attack date, and many attacks occur earlier and later. Also, weather conditions can make major changes in this "average" picture. For example in Colorado in 1969, an extended period of cool, rainy weather in mid to late August appeared to extend the attack period markedly, possibly almost to mid September.

In summary, we believe that the post-attack cacodylic acid method can be successful in killing beetles if proper attention is given to timing and other operational details. As Chansler et al. (1970) pointed out, good treatment in itself is not sufficient to insure good control; area layout, spotting, and other operational considerations are equally critical. Poor performance in one or more of these areas can make a good job of treating a totally wasted effort.

Table 1.--Gallery, brood and bluestain conditions at time of treatment, 1969-72

Experiment location and treatment date	Mean egg gallery length	Brood status	Bluestain	Longest larval mines
	- - Inches - -			- Inches -
South Dakota 1969				
September 5	10.0	Eggs	None	0
September 19	15.7	Larvae	Light	0.5
October 3	12.8	Larvae	Light	1.0
October 17	18.7	Larvae	Well developed	1.3
October 31	24.3	Larvae	Well developed	1.8
November 14	27.6	Larvae	Well developed	1.8
Colorado 1969				
September 11	5.2	Eggs	Light	0
September 18	22.1	Larvae	Light	.5
October 2	31.2	Larvae	Light	1.0
October 16	14.0	Larvae	Well developed	1.5
October 30	37.8	Larvae	Well developed	1.0
South Dakota 1970				
August 21	2.8	Eggs	--	0
August 28	12.4	Larvae	--	.5
September 4	15.2	Larvae	--	1.2
September 12	16.0	Larvae	--	.8
September 23	15.8	Larvae	--	1.5
Colorado 1972				
August 17	3.9	Eggs	None	0
August 25	12.8	Larvae	None	--
September 6	8.5	Larvae	Light	--
September 15	--	Larvae	Light	.8
September 25	--	Larvae	Well developed	2.0

"--" No data available.

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### PESTICIDE PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.



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